

University Physics II Honors Project

Wind Turbine

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Section H2

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Introduction

“Wind is an unseen form of energy which may be harnessed for practical application.”

(Twidell, Wind Energy, 4.) Wind turbines provide an environmentally friendly method of energy production utilizing a renewable resource to power the daily lives of billions of people around the world. Turbines work by slowing down the air molecules of the wind to spin blades attached to magnets. (Park, Common Sense, 23.) These moving magnets rotate over multiple coils giving each coil a change in magnetic flux. According to Faraday’s Law the electromotive force, emf (V), in a closed circuit is equal to the negative rate of change of the magnetic flux. It is the aim of this project to construct a wind turbine to illustrate Faraday’s law.

Materials

26 gauge enameled copper wire	automobile fan
6 neodymium magnets (2.2 cm diameter)	6 washers
wooden dowel (0.75 cm diameter)	super glue
circular craft plywood	electrical tape
digital multimeter	sand paper
2 test leads	

Procedure

For this project multiple models of wind turbines were researched and Savonius' design was chosen as a base model for its simplicity of building and physics concepts. (Mussell, Wind Turbine, 1.) For the coils 26 gauge enameled copper wire was chosen due to its low resistivity and thin insulation. This is important to maximize the voltage output. In order to determine the optimal number of turns per coil, the electromotive force of multiple coils of varying turns was measured and compared as shown below.

Number of Turns	Trial 1 emf (mV)	Trial 2 emf (mV)	Trial 3 emf (mV)	Trial 4 emf (mV)
10	0.2	0.5	0.3	0.2
20	0.7	0.6	1.0	0.8
30	1.1	1.3	1.4	1.1

Table 1: Electromotive force by number of turns in coil

From this data it is seen that as the number of turns per coil increases, the induced current increases. Due to limited supplies it was decided to construct the wind turbine with twenty loops per coil with the understanding that this would result in a limited electromotive force.

For blade construction multiple materials were considered including quartered PVC pipe, shaped basilica wood, and a manufactured automobile fan. In order to best depict the applications of this device as well as the physics of the turbines operation, the automobile fan was decided to be the most appropriate material for the set objectives.

When a force was applied to the fan blades the multimeter measured a maximum voltage ranging from 5.6 mV to 7.4 mV as shown in the data table below. The mean of these trials was 6.4 mV.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
max emf (mV)	7.4	5.6	6.4	6.7	5.7

Table 2: emf of turbine

Diagrams



Figure 1: System with leads connected to multimeter



Figure 2: Close view of fan with coils underneath

Conclusion

For this design the wind spins the blades of the device which moves magnets over multiple coils of copper wire. This change in magnetic flux through each coil induces an electromotive force through the coils which was measured by the multimeter as ranging from 5.6 mV to 7.4 mV with a mean of 6.4 mV. This voltage could be increased by increasing the number of loops in each coil, increasing the strength of the magnets used, or using a lighter fan to increase the time rate of change of the flux. Although this is not a high voltage output it is consistent with Faraday's law of inductance.

Sources

Mussell, Dave. "Build Your Own Wind Turbine." Accessed November 27, 2010.

<http://www.re-energy.ca/docs/wind-turbine-cp.pdf>

Park, Jack, and Overmeier, John. Common Sense Wind Energy. Sacramento: California Energy Commission: Office of Appropriate Technology, 1982.

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